

Where the Sidewalk Ends: Resolving the Middle Bakken and Three Forks Field Boundaries by Appropriately Modifying Herron's Permeability Model, Dunn Co., ND.

Joe C. Bauman¹ and Yinghao Chen¹

¹Hunt Oil Company

Abstract

Well performance demonstrates that the operator's acreage is situated on or near the commercial boundary of the Middle Bakken reservoir, Dunn County, North Dakota. The commercial boundary of the underlying Three Forks Formation is less clearly delineated as fewer Three Forks tests have been conducted, such tests utilized varying vintages and styles of completions, and routine petrophysical analyses of area logs yield results inconsistent with observations or expectations of performance. An empirical relationship has been observed between pore size distribution as determined by NMR logs and productive vs non-productive reservoir in the Middle Bakken and Three Forks Formations. However, such logs are run infrequently, and none are available within the operator's immediate area. Advanced core analyses (e.g., core NMR, XRD, mercury injection) can also yield important data, but are similarly seldom conducted and only distally available. Permeability, as it often relates to pore size, may act as a proxy to pore size but is similarly determined from NMR or cores (and as such is infrequently run or unavailable in the immediate area). However, many previous workers have developed permeability models with varying degrees of success by utilizing mineralogy and commonly available log suites. Within the immediate area of the operator's acreage are many vertical logs of varying vintages, which are typically comprised of triple combos (Density, Neutron Porosity, and Resistivity log curves), and occasionally include Sonic logs. By calibrating mineralogy models to regional XRD & ECS data, and by modifying Herron's permeability equation parameters to account for tidal flat and sabkha dolomite, a permeability model utilizing only triple combo logs has been derived that yields an answer consistent with NMR permeabilities and observations of well performance. Furthermore, intermediary observations make implications about the mechanism of the Middle Bakken and Three Forks field boundaries in Dunn County, North Dakota, and comparisons of our derived permeability vs NMR permeability suggest matrix permeability may be distinguished from fracture contribution.